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Chemical Abundances in the Galactic Center

Solange V. Ram,írez[1] Katia Cunha,[2] Kris Sellgren,[3] Verne V. Smith,[2]
Robert D. Blum,[2] and Donald Terndrup[3]

Abstract. We present chemical abundances in a sample of luminous cool stars located within 50 pc of the Galactic Center. Abundances of C, N, O, Ca and Fe are derived using high-resolution infrared spectra in the H- and K-bands. We report solar iron abundance, enhanced alpha element abundances, and CN-cycle mixed material in the atmospheres of these evolved stars.

Our group has been involved in the determination of chemical abundances of cool luminous stars in the Galactic Center (GC) since 2000 when we reported Fe abundance results of 10 stars within 50 pc of the GC (Carr et al. 2000; Ramírez et al. 2000). Recently, Cunha et al. (2007) reported C, N, O, and Ca abundances in the same sample. The determined abundances were obtained from high-resolution infrared spectra in the $H-$ and $K-$ bands taken with CSHELL at the IRTF and Phoenix at Gemini-South using the spectral synthesis program MOOG (Sneden 1973). Our results can be summarized as:

- The stellar iron abundance in the GC is near-solar or slightly elevated, with a mean value of $< [Fe/H] >= +0.14 \pm 0.06$ dex.
- The CN abundances are mixed with CN-cycle material in all our sample stars (IRS 7 shows additional mixing with ON-cycle material).
- The $\alpha-$element abundances are enhanced with respect to disk values at similar iron abundances with mean values of $< [Ca/Fe] >= +0.27 \pm 0.14$ dex and $< [O/Fe] >= +0.22 \pm 0.15$ dex (not including IRS 7).

The left panel in Figure 1 shows the behavior of [O/Fe] and [Ca/Fe] vs. [Fe/H] for different populations. The Galactic disk and halo trends are interpreted as increasing Fe abundance (fron SN Ia) with time. GC stars have enhanced [O/Fe] and [Ca/Fe] at the same [Fe/H], implying that GC stars may be enriched with SN II chemical yields. The right panel in Figure 1 displays the abundance of O (top), Ca (middle), and Fe (bottom) with galactocentric distance (R_g) for disk and GC stars. The disk values of [O/H], [Ca/H], and [Fe/H] show increasing abundances with decreasing galactocentric distance. The GC abundances fall near, or below, a smooth extrapolation of the disk trends. Our results, recently confirmed by independent abundance studies (Najarro et al. 2009; Davies et al. 2009), are consistent with either a top-heavy IMF or with enrichment by gas infall from the bulge.

[1]NASA Exoplanet Science Institute, California Institute of Technology

[2]National Astronomical Optical Observatories

[3]The Ohio State University

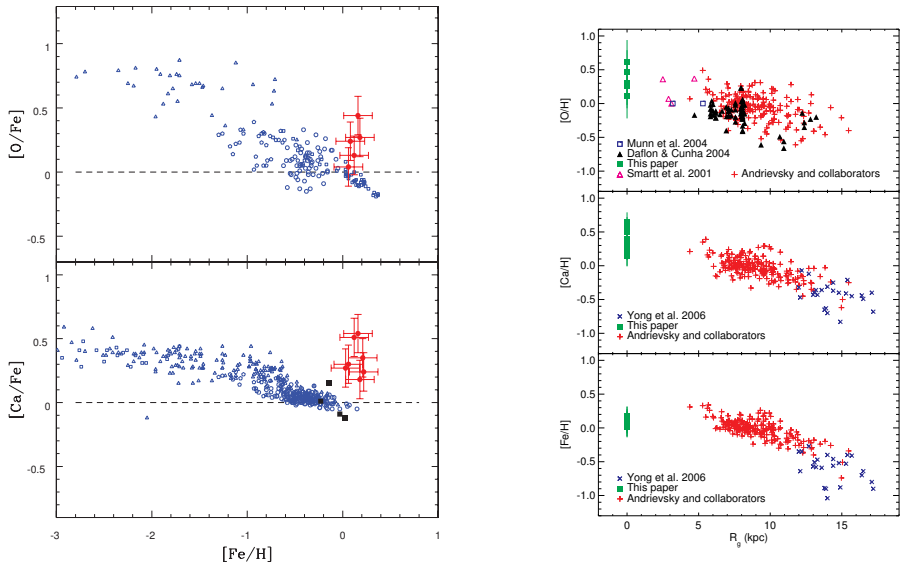

Figure 1. Left: [O/Fe] and [Ca/Fe] vs. [Fe/H] for different populations: blue symbols are Galactic disk and halo field stars (squares (Bensby et al. 2004); circles (Reddy et al. 2003); pentagons (Nissen & Schuster 1997); triangles (Fulbright & Johnson 2003)), black squares are our disk stars and red circles are GC stars. Right: O (top), Ca (middle), and Fe (bottom) abundance with galactocentric distance (R_g), including disk stars (OB stars: (Munn et al. 2004; Daflon & Cunha 2004; Smartt et al. 2001) and Cepheid stars: (Andrievsky et al. 2004; Yong et al. 2006)). GC stars are in green squares.

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References

Andrievsky, S. M., et al. 2004, A&A, 392, 491
Bensby, T., et al. 2004, A&A, 415, 155
Carr, J. S., et al. 2000, ApJ, 530, 307
Cunha, K., et al. 2007, ApJ, 669, 1011
Daflon, S., Cunha, K., 2004, ApJ, 617, 1115
Davies, B., et al., 2009, ApJ, 694, 46
Fulbright, J. P., Johnson, J. A., 2003, ApJ, 595, 1154
Munn, K. E., et al., 2004, A&A, 419, 713
Najarro, F., et al., 2009, ApJ, 691, 1816
Nissen, P. E., Schuster, W. J., 1997, A&A, 326, 751
Ramírez, S. V., et al. 2000, ApJ, 537, 205
Reddy, B. E., et al., 2003, MNRAS, 340, 304
Smartt, S. J., et al., 2001, A&A, 367, 86
Sneden, C. A., Ph.D. Thesis, University of Texas at Austin
Yong, D., et al., 2006, ApJ, 639, 918